WARM-UP E

TRACKING AIR QUALITY

This exercise lets students graph changes in the weather that have implications for air quality in the community. It is related to the activities called "The Greenhouse Effect," and "Climate and the Greenhouse Effect." This exercise is best conducted over a long period of time (especially in the Fall) in order for students to observe significant variations in the Air Quality Index and correlate them with weather parameters.

CRITICAL OBJECTIVES

- Observe the impact of weather on air quality
- Demonstrate data gathering, analysis, graphing, and presentation skills
- Apply techniques of comparison and critical thinking

SKILLS

- Researching
- Observing
- Collecting and analyzing
- Graphing
- Interpreting

GUEST PRESENTERS

Guest presenters could include air quality engineers, environmental scientists, or meteorologists.

BACKGROUND

Graphing—the ability to depict information, relationships, and trends—is a basic skill for communicating ideas and sharing information. It is a skill that supports endeavors in science and mathematics. It is with graphical analysis that scientists and engineers at EPA look for relationships and processes that are not immediately apparent with single, one-time measurements.

Conceivably, this activity could be conducted througsulphurhe year or periodically to build a data set large enough to establish seasonal trends and determine indicators of change. When the same collecting techniques are applied to air pollutants, the accuracy, frequency, location, and testing protocol become critical for obtaining useful data with which to explain the movement of pollution in the environment and the extent to which we are exposed to air pollutants.

Pollutants in the air come from many sources. Natural air pollution caused by volcanoes, forest fires, and other natural sources has always existed,

RELATED ACTIVITIES
12, 13

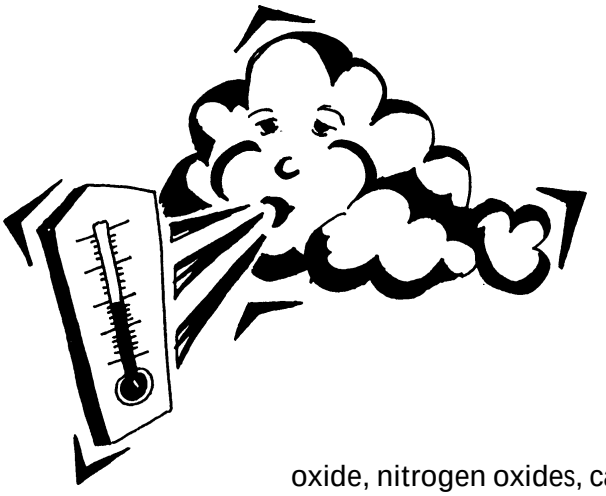
REFER TO READING MATERIAL
"Weather and Air Quality"

TARGET GRADE LEVEL
6th - 10th

DURATION
Class #1: 15 minutes;
Classes #2-5 (over 2-to-6-week period): 5 minutes each;
Class #6: 40 minutes

VOCABULARY
Air Quality Index
Carbon monoxide
Criteria pollutant
Lead
Nitrogen oxides
Ozone
Particulate matter
Precipitation
Relative humidity
Sulphur dioxide
Temperature
Thermal inversion

MATERIALS
Five sheets of white (or light colored) poster board or heavy construction paper each measuring 2 feet by 2 feet
Felt-tip markers in black, green, blue, red, purple, orange (1 in each color)



and naturally produced pollutants are present in greater amounts than those made by humans. They do not present as serious a problem as man-made pollutants, however, because they are dispersed over large areas and many are less harmful. Air pollutants from man-made sources are the result of our increasing use of large quantities of fuel to produce electricity and to run everything from factories to automobiles and other vehicles. Not only are some of these pollutants very harmful, but also they tend to be concentrated in urban areas where most people live and work. Six of the major man-made pollutants—sulphur dioxide, nitrogen oxides, carbon monoxide, ozone, lead, and particulate matter—have been designated "criteria" pollutants and are regulated by the federal government.

Daily weather conditions directly affect whether and how much we are exposed to pollutants in the air. Shifting air masses (weather systems) and wind can move pollutants from one place to another. On the other hand, stationary air systems, like thermal inversions, can trap harmful pollutants over an area for days at a time. Rain, snow, and other forms of precipitation help wash pollutants from the air and onto the ground. While precipitation cleanses the air we breathe, it also may increase pollution of the land and surface water.

Meteorologists use the Air Quality Index to classify and measure contaminants in the air and report conditions to the public. The index is used to convert data from air monitoring stations at various locations around a community to a scale that indicates the potential effects of measured levels of various contaminants, including the "criteria" pollutants (listed above), on human health, property, and vegetation. This information enables local government officials to take appropriate protective steps in thchalkboardarmful conditions like thermal inversions and smog. (See reading material on "Weather and Air Quality.")

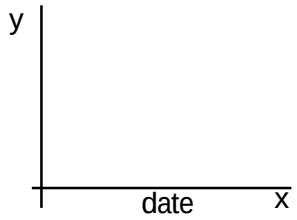
WHAT TO DO

Class #1

1. Divide the class into five teams and assign each team one of the following five weather parameters: Temperature, Wind Direction, Precipitation, Air Quality Index, and Relative Humidity.

2. Explain that each team will record daily changes in these aspects of the weather on posted graphs over a period of time (specify the period). At the end of the selected period, each team will prepare their findings and make a short presentation defining the aspect of the weather they have been tracking. Where appropriate, students should record the range of values (for example, the high and low temperatures for the day) and a mean value.

3. Give each team a sheet of poster board. Instruct them to draw a graph on their posters that will allow them to track published information about the weather aspect they have been assigned. (Teams should share the black markers for this task.) The "x" axis for all the graphs should be "date."



4. Encourage students to call the local weather bureau or the weather reporter at the local television station for help in determining the appropriate "y" axis range for the parameter they have been assigned. Suggest that the students obtain data to fill in their graphs from the local weather bureau, weather reporter, or newspaper.

5. Hang or otherwise display the posters in the classroom where students can see them and record data on them each day. The teams should be given the flexibility to organize themselves to ensure that the recording of data is accomplished every day.

Classes #2-5

1. Take five minutes during each class to call attention to the status of the graphs and give students a few questions to consider in preparation for the discussion at the end of the exercise. For example: Would you expect some aspects of the weather to have more (or less) influence on the quality of the air we breathe? If so, which ones and why? The Air Quality Index is usually expressed for particular contaminants—such as ozone, sulphur dioxide, and ragweed pollen. From your observation, does it appear that changes in weather have more (or less) effect on air quality for some contaminants? If you have found no correlation, does that mean there is no effect? Is there another, better approach for determining a correlation?

2. During one of the classes near the end of the data collection period, give students a few additional questions to address in the presentations to be made in the final class. For example: How would you describe the weather in our area? What causes the weather to be like it is? Is the weather different elsewhere? If so, what causes it to be different in different places? Suggest that students brainstorm with their teammates and present the group's perspective in their presentations.

Class #6

1. Before teams prepare their data for presentation, repeat the questions you posed during the periodic status checks—Would you expect some aspects of the weather to have more (or less) influence on the quality of the air we breathe? If so, which ones and why? The Air Quality

Index is usually expressed for particular contaminants—such as ozone, sulphur dioxide, and ragweed pollen. From your observations, does it appear that changes in weather have more (or less) effect on air quality for some contaminants? Encourage discussion.

2. Have each team make 5-minute presentations defining the weather parameter they have been assigned, reporting on the data collected, and addressing the general questions you posed in an earlier class. (See item 2 in the previous section.)

3. Ask the teams to compare the graphs. Now that they have seen all the data, ask if they would change their answers to any of the questions discussed at the beginning of class. Ask them to explain why (or why not).

4. Give each team one of the colored felt-tip markers. Encourage students to use the markers to point out similarities (or wide variances) between data on different graphs to illustrate and support their answers.

5. Encourage students to discuss what the results of this exercise might mean (for example, if the data collection period is "typical" for this time of year, how the weather might stress people with asthma or other respiratory problems, and how it might affect plants and trees in the area, or even their pets.) Have them discuss possible options for making the air quality better in these kinds of weather conditions.

6. Ask the students how they would determine whether their assumptions and conclusions are correct. End the class by recording on the chalkboard a list of their ideas. (The list should include going to the library to do research and talking to the local weather bureau, meteorologists, physicians, or local Health Department personnel.)

SUGGESTED EXTENSIONS (OPTIONAL)

- Assign each team to act on one of the ideas offered for verifying the validity of conclusions and write a report to present in class.

- Look up historical weather data (go through local newspapers or other sources recommended by the weather bureau) for the same period in previous years. See if a pattern or relationship can be found between the conditions in previous years and the data collection period for this exercise by graphing the historical data in the same manner as the current data and comparing it with the current graphs.

SUGGESTED READING

Albers, Daniel. "What Makes a Rainy Day?" *Sierra*, 74 (November 1989) p. 104.

Baines, John. *Conserving Our World, Conserving the Atmosphere*. Austin, TX: Steck-Vaughn Company (1990).

Catherall, Ed. *Exploring Weather*. Austin, TX: Steck-Vaughn Company (1990).

Clark, John Owen Edward. *The Atmosphere*. New York: Gloucester Press (1992).

"Climate: Worldwide Weather Threatens Millions." *USA Today Magazine*, 117 (April 1989) p. 1.

Cosgrove, Brian. *Eyewitness Books: Weather*. New York: Alfred A. Knopf (1991).

Freiman, Chana, and Nancy Karkowsky. "Weathering the Summer of 1993." *Science World*, 50 (22 October 1993) p. 10.

Gibbons, Gail. *Weather Forecasting*. New York: Chelsea House Publishers (1992).

Trefil, James. "Modeling Earth's Future Climate Requires Both Science and Guesswork." *Smithsonian*, 21 (December 1990) p. 28.